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**AN ECOLOGICAL SKETCH OF THE FLORA OF SANTO DOMINGO.**

BY JOHN W. HARSHBERGER, PH. D.

The island of Santo Domingo (Hispañola of Columbus) is politically divided into an eastern and a western portion. The eastern section, by far the largest, comprises the Republic of Santo Domingo, and the western area, the smallest, is dominated by the blacks of the Haitian Republic. The island of Santo Domingo is one of extreme fertility. Columbus, and travelers since, speak in the highest terms of the rare beauty and natural grandeur of the island, which has been called without exaggeration "The Queen of the Antilles."

**TOPOGRAPHY.**

Hispañola by nature is the geographic centre of the Greater Antilles. Thomas Jefferys in 1760 said: "Its situation with respect to the rest of the Antilles is the most advantageous imaginable, as it stands, you may say, in the centre of this great cluster of islands, and looks as if intended by nature to give laws to them. The other three great Antilles lie in such a manner as to prove its superiority, and their own dependence; for it has three points of land corresponding respectively to each island" (Puerto Rico, Cuba, Jamaica). Santo Domingo excels Puerto Rico, Cuba and Jamaica in altitude, diversity of configuration, picturesque aspect and natural fertility. It is continental in its topographic make-up, being the radiating centre of the great Antillean uplift. The outline of Hispañola is the most irregular of all the Greater Antilles, its periphery being nearly a thousand miles, its length 400 miles, and its breadth 160 miles. The great Gulf of Gonaives is enclosed by the western peninsulas, and is an immense semicircular bay with a coast line of two hundred miles. Samana Bay on the northeast, Barahona Bay on the south coast and Manzanilla Bay on the north are also conspicuous indentations. Approached from the ocean, the island presents a huge mass of mountains

rising precipitously from the sea, extending in all directions and apparently jumbled up in hopeless confusion. The mountains consist of lofty forest-covered peaks, resembling the Alleghenies, the Alps or the Pyrenees, but with this difference, that they are always without snow. There are four ranges of mountains which run in a general east-and-west direction, as follows: The northern fragment is the Monte Cristi Range; the main orographic section, the Sierra Cibao, consists of lofty mountains, with the third range as an outlier toward the southwest, and the fourth mass is formed by the tall mountains of the southwestern peninsula. Between these ranges lie extensive fertile valleys, threaded by streams of limpid water. Many of these streams debouch on the plains which fringe the sea-coast, and irrigate those coastal areas which are more or less arid in condition, being shut off from the prevailing winds and rains by lofty mountain summits. There are many central valley plains in the island. The largest of these, lying between the Monte Cristi Range and the Cordillera Cibao, extends from the sea at the Haitian border to Samana Bay, its eastern prolongation. The western portion, watered by the Yaqui, is an arid region covered by chaparral, where arborescent opuntias and cereuses abound. The windward area, or eastern division, watered by the Yuna, is covered by beautiful deciduous plants. South of the Cibao Range is the extensive plain of Seylo, covered in part by open prairie and forest. The terraced Caribbean coast supports a belt of forest averaging twelve miles in width. The tension line between coastal forest and inland prairie is parklike in aspect, carpeted by green grass and dotted by clumps of trees. At Azua, the whole neighborhood is barren, dry and thorny. The only lakes are salt, occupying the east-and-west depression which separates the southern peninsula of Haiti from the main portion of the island. This basin, formerly an oceanic inlet, is said to be inhabited still by sharks, porpoises and even crocodiles.

The configuration of the Haitian division of the island appears an agglomeration of mountains, hills and valleys most irregular in form. There are precipices, deep hollows, vales apparently without outlet, but with water glistening below. The whole of the Republic is more or less mountainous. The La Haute Mountains are most noted and they form a continuation of the great axial sierra of the island. There are many beautiful slopes and valleys.

Those of Port-au-Prince, Gonaïves, Artibonite, Arcahaïe, Port Margot, Léogane, Aux Cayes being the most famous. Three large islands are attached to the Haitian coast—Tortuga on the north, Gonave on the west are noted for their mahogany trees; L'Ile-a-Vache on the south coast lies in a sound of the same name.

#### CLIMATE.

The dry season covers the period of the year from October to April, when the temperature is some  $10^{\circ}$  lower than during the so-called rainy season, which lasts from April to October, when rains fall, as a rule, late in the afternoons or evenings. In general, the climate of the island of Santo Domingo is most diversified, presenting wide extremes of moisture, aridity and temperature. At the sea-level, in sheltered places, the heat is intense, but as one ascends the mountains of the interior the heat of the seaboard becomes moderated. At 1,600 feet, European and American travelers complain of cold at night, although there the mercury never falls below  $45^{\circ}$ . Rain is almost lacking on the lower slopes of sheltered mountains, but above 2,000 feet rains and dews are copious. The nights are from  $10^{\circ}$  to  $20^{\circ}$  cooler than the days.

#### ECOLOGY.

The information for the following ecologic sketch was obtained from three sources: (1) The observations of the writer made upon the flora of Haiti during July, 1901, when he visited the island, stopping at four ports, viz., Cape Haitien, Port-au-Prince, Aux Cayes and Jacmel; (2) The information gleaned by conversation with inhabitants of the island familiar with its vegetation; (3) A careful perusal of Tippenhauer's book, *Die Insel Haiti*. It is impossible to give a detailed sketch of the phytogeography of the island of Hispaniola. It seems, therefore, best to assemble the species in an ecologic manner as a basis for a future work upon this rich and most luxuriant insular vegetation.

*Hydrophytes*.—Living along shore in the bays and shallow estuaries is found an abundant mangrove vegetation. In Port-au-Prince Bay, at Cape Haitien, at Aux Cayes, are found extensive mangrove swamps and islands. The three trees concerned in forming the mangrove association are *Rhizophora mangle* L., *Avicennia*

*officinalis* L. and *Laguncularia racemosa* Gaertn. *Pistia stratiotes* L. floats in the fresh-water streams of the island, or loosely attached to the soil along their banks. *Sagittaria lancifolia* L. may also be classed as a hydrophyte.

*Mesophytes*.—The plants composing the vegetation of a tropical forest are in superimposed layers, or stories. The different levels at which tropical plants grow is in direct response to the environmental conditions of light and moisture. These storied layers may be termed vegetal strata. It may be stated, in this connection, as axiomatic, that in a tropical forest, when one ascends from the ground to the crown of the dominant forest trees, as the light increases the moisture content of the air decreases. On the ground in the forest, mosses, ferns and fungi abound in the deep shadow and growing in the mould arising from fallen leaves and rotting wood. In the forests, on the trees, ferns, aroids and orchids are found, while serpent-like lianes clamber from limb to limb and from tree to tree, until they reach abundant light in the crowns of the trees above. Epiphytes and parasites, more or less xerophytic in habit, are found in the tops of the dominant species of trees.

*Forest Vegetation*.—The richness of the tropical flora and the lush growth of the vegetation in general is most marked in those situations that are exposed to the copious rains that fall during the summer months. The drenching rainfall, the richness of the soil in the mountain valleys and coastal plains are such as to encourage to the highest degree a luxuriant fern and arboreal vegetation. Along the banks of streams occur *Bambusa vulgaris* Schrad., *Heliconia* sp., *Amomum* sp., and of the palms, *Oreodoxa oleracea* Mart., *Thrinax argentea* Lodd, *T. parviflora* Sw., *Acrocomia sclerocarpa* Mart., *Euterpe oleracea* Engelm.

The component vegetation of damp woods consists of *Musa sapientum* L., *M. coccinea* Andr., *Heliconia bihai* L., *H. psittacorum* L., *Arundo occidentalis* Sieber, *Canna edulis* Ker-Gawl, *Swietenia mahagoni* Jacq., *Hamatoxylon campechianum* L., *Machura tinctoria* D. Don., *Cedrela odorata* L., *Artocarpus incisa* L., *Chrysophyllum cainito* L., *Catalpa longissima* Sims, *Sloanea dentata* L., *Swartzia tomentosa* D.C., *Ilex obcordata* Sw., *Cecropia peltata* L., and other arborescent species. The larger trees are draped by lianes of the following species: *Passiflora cærulea* L., *P. lauri-*

*folia* L., *P. perfoliata* L., *Aristolochia arborescens* L., *Entada scandens* Benth., *Philodendron lacerum* Schott. and *Vitis caribæa* D.C.

*Savanna Vegetation.*—The green covering of the open park-like areas, or savannas, consists of grasses and other herbaceous plants. The grasses are of most interest from an economic standpoint and should be mentioned first. The following seem to be the chief components of the grassy stretches of savanna land: *Paspalum platycaule* Poir., *P. distichum* Linn., *P. virgatum* Linn., *P. paniculatum* Linn., *Chloris ciliata* Sw., *C. cruciata* Sw., *C. barbata* Sw., *Panicum colonum* Linn., *P. maximum* Jacq., *P. hirsutum* Sw., *Andropogon saccharoides* Sw., *A. gracilis* Spreng., *A. fastigiatus* Sw., *A. bicornis* L., *A. leucostachys* H. B. and K., *Eragrostis ciliata*, with herbaceous plants, *Desmodium axillare* D. C. and *Boerhaavia erecta* Linn.

*Epiphytes.*—The large trees, such as the figs, the mahogany, the silk cotton, are loaded down with a considerable number of epiphytes belonging to the orchid, fern, cactus and aroid families. Foremost among these air-dwellers are two members of the natural order Cactaceæ, viz., *Cereus triangularis* Mill and *Rhipsalis cassytha* Gaertn., which live in the crotches or attached to the upper side of the limbs of tropical forest trees. Here are seen, also, *Philodendron lacerum* Schott., *Polypodium aureum* L., *Vittaria lineata* Swartz, species of *Epidendrum*, and the following plants of the genus *Tillandsia*: *T. angustifolia* Sw., *T. complanata* Benth., *T. bulbosa* Hook., *T. compressa* Bert., *T. excelsa* Griseb., *T. fasciculata* Sw., *T. flexuosa* Sw., *T. laxa* Griseb., *T. pruinosa* Sw., *T. setacea* Sw., *T. usneoides* Linn.

The aerial life, therefore, seems to be of incontestable value to these plants. Here they are installed in a position which offers the largest amount of sunlight, and this advantage of increased illumination seems to outweigh any disadvantage which the species might have in running a constant risk of death by desiccation.

*Parasites.*—There are a number of true parasites to be found attached to and living upon the trunk and limbs of various tropical forest trees. Parasites of the genus *Phoradendron*, with rounded or four-cornered stems, opposite or whorled, palmately veined, leathery leaves, are among the most prominent. The following species of the genus have been recorded as occurring in

the island: *Phoradendron berterianum* Nutt., *P. flavescens* Nutt., *P. schottii* Nutt., *P. rubrum* Nutt. The genus *Dendrophthora* (formerly included in *Arceuthobium*) consists of parasites, that are represented in the Santo Domingan flora by *Dendrophthora cupressoides* Eichl., *D. gracile* Eichl., *D. opuntioides* Eichl.

*Xerophytes*.—The writer has briefly alluded to the stretches of country that may be said to be of arid nature in referring to the topography of Santo Domingo. These desertic areas are usually found on the slopes of mountains and in valleys that are sheltered by their position from the prevalent summer rains. These rains may be denominated trade-wind rains, because they owe their origin to the strong evaporation of water within the zone of the trades. If the trade wind encounters a mountainous island, or a bald continental coast, the ascent of air over such obstructions cools it, and the water in the clouds, thus formed, descends as rain. For this reason the windward slopes of Santo Domingo are well watered, while the leeward slopes are comparatively dry. Again, if the trade winds blow over a land of moderate elevation no precipitation occurs, but the winds reduce its surface to a dry desert by depriving it of moisture. In the Republic of Haiti, as well as in that of Santo Domingo, there are many arid situations which owe their barrenness to just such causes. Consequently in such arid districts we naturally look for a xerophytic flora. The species which exist in such situations are the following: *Opuntia tuna* Mill., *O. spinosissima* Mill., *Cereus moniliformis* D.C., *C. grandiflorus* Mill., *Nopalea coccinellifera* Salm Dyck, *Mammillaria simplex* Haw., *Melocactus communis* Link and Otto, *Pereskia aculeata* Mill. To this list of succulents belonging to the cactus order should be added several other fleshy plants, viz., *Agave sobolifera* Salm Dyck and *Aloe vulgaris* Lam. The arid hillsides are generally covered, in addition to the xerophytes mentioned above, with thickets of *Acacia farnesiana* Willd., *A. sphærocephala* Cham. and Schlecht., the mezquite, *Prosopis juliflora* D. C., *Yucca aloifolia* Linn. and *Yucca gloriosa* Linn.

The native flora has been undisturbed on the slopes of the higher mountains inland. Some of the most valuable timber trees have been removed, but cutting them has rather improved the botanical interest of the country, because the smaller plants have thus had a chance to grow. Around the dwellings, however, and in the

cultivated valleys, great changes have been worked in the flora. The indigenous plants have been slowly replaced by introductions from tropical and temperate climes.

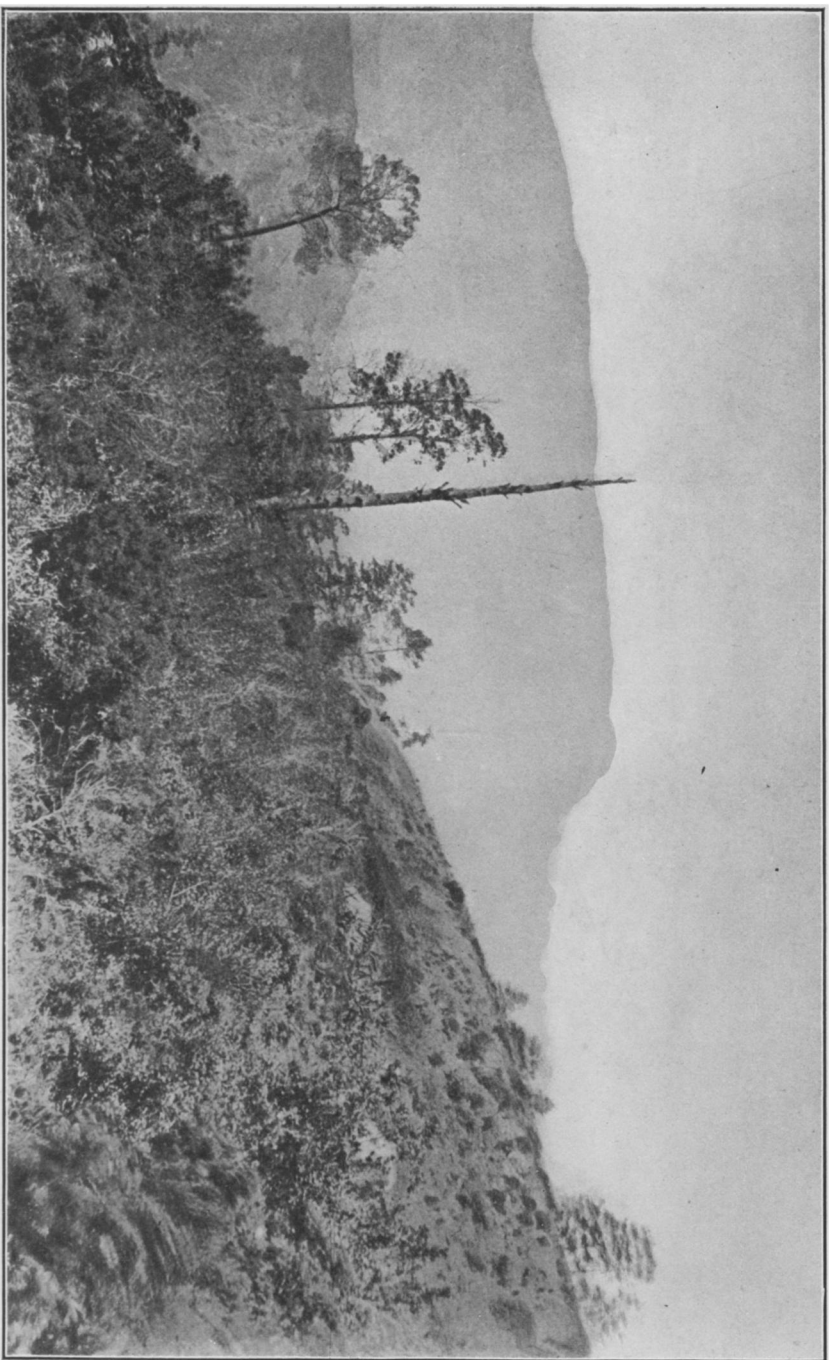
A typical valley which has been modified by human agency was visited by the writer near the town of Cape Haitien, on the north coast of the island. A description of the flora of this valley will serve to illustrate the influence of cultivation upon the primitive surroundings. The ravine in question is situated just back of the town of Cape Haitien, between the mountain of the cape and the main range to the south and southwest. A mountain stream of limpid water runs down through the depression, and a bridle path winds its way to the top of the hills overlooking the sea. Both banks of the brook are covered with arborescent vegetation, except where the gardens of houses are found, or where banana plantations are made. The following trees are met in the rich soil of the valley: The bread-fruit, *Artocarpus incisa* Linn.; the star-apple, *Chrysophyllum cainito* Linn.; the mango, *Mangifera indica* Linn.; the banana, *Musa sapientum* Linn.; the bamboo, *Bambusa vulgaris* Schrad.; the coffee, *Coffea arabica* Linn.; the guava, *Psidium guajava* Linn.; the trumpet tree, *Cecropia peltata* Linn.; the chocolate, *Theobroma cacao* Linn.; the alligator pear, *Persea gratissima* Gaertn. The banana fields are planted on the steep declivities and consist of a pure growth without the admixture of coffee plants and chocolate shrubs. Along the roadside are found the following: *Adiantum pedatum* Linn., *Asplenium pellucidum* (?), *Argemone mexicana* Linn., *Lepidium virginicum* Linn., *Mimosa pudica* Linn., *Momordica charantia* Linn., *Hibiscus trilobus* Aubl.

An occasional small maize field is interspersed with banana plantations. The gardens of the houses along these roads are not rich in species or in showy plants. Most of them suffer from neglect. There is an apparent poverty of decorative plants and a great uniformity is noticeable in the garden plants of adjacent properties. A list of a few garden plants may here be given: *Musa sapientum* Linn., *Hibiscus esculentus* Linn., *H. sabdariffa* Linn., *Lycopersicum esculentum* Mill., *Solanum melongena* Linn., *Cucurbita pepo* Linn., *Gynandropsis pentaphylla* D. C., *Capsicum annuum* Linn., *C. baccatum* Linn., *Zingiber officinale* Rose., *Dioscorea alata* Linn., *Punica granatum* Linn., *Fragaria vesca* Linn.

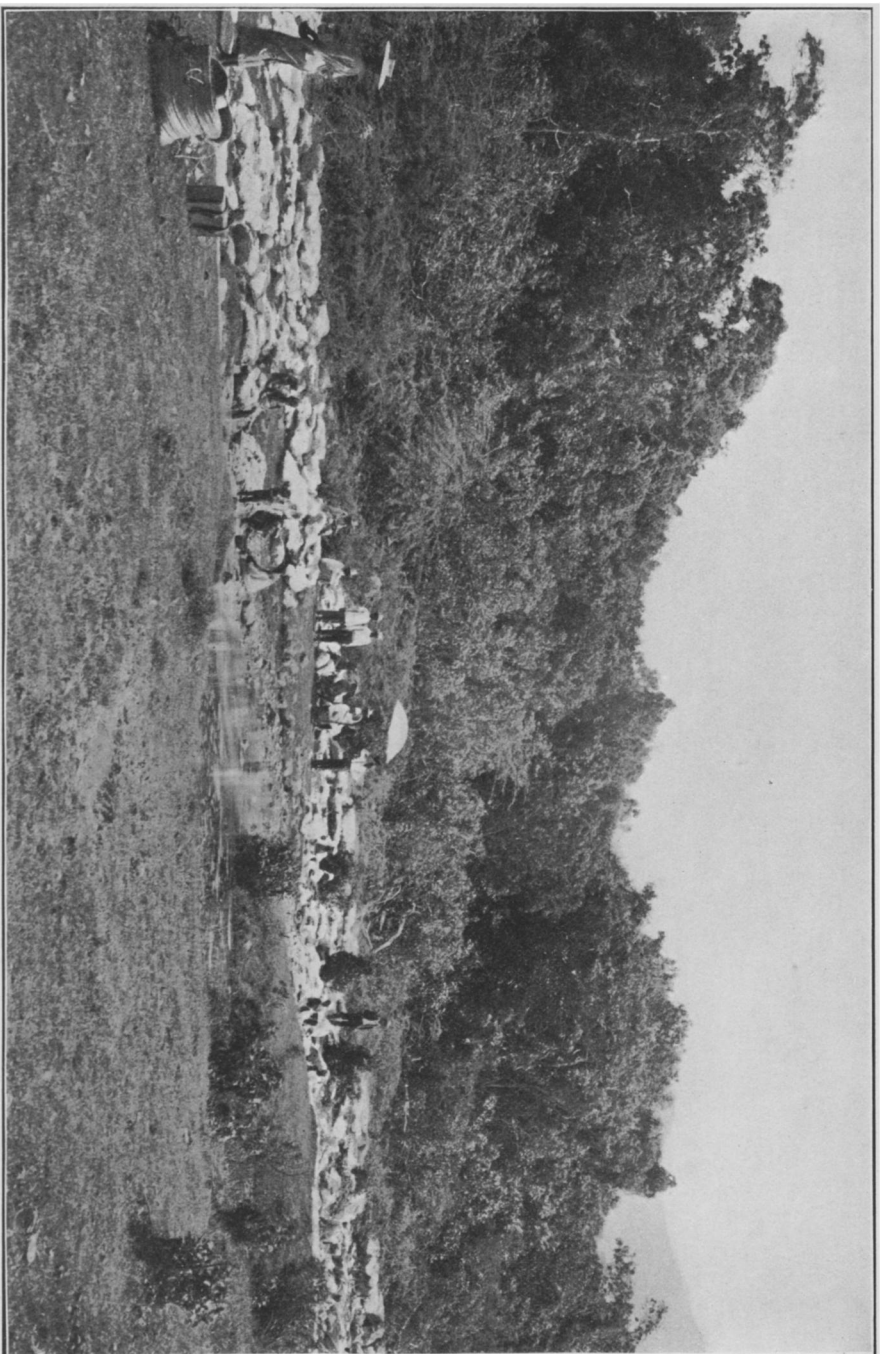


Near Port-au-Prince a hillside was visited which supported an almost pure growth of *lignum vitæ*, *Guaiacum officinale* Linn.; the mezquite, *Prosopis juliflora* D. C., and the acacias, *Acacia sphaerocephala* Cham. and Schlecht., *Acacia farnesiana* Willd., while on rocky outcrops in open places in these woods was found a growth of yuccas, probably *Yucca aloifolia* Linn.

This brief sketch of the ecology of the flora of Santo Domingo suffices to show that an interesting and profitable field of investigation lies at the doors of the American botanist. The West Indies, in their varied topographical configuration, are especially adapted for philosophical inquiry into the causes which have influenced the distribution of plants on the North American continent. The writer believes, since his visit to Haiti and Jamaica, that the solution of this phyto-geographic problem will follow a careful biological survey of the fauna and flora of the Greater and Lesser Antilles.



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